COOP'S TECHNOLOGY DIGEST

AUGUST 01, 1993 / Volume 93-08-001

DIGITAL TELEVISION BACKGROUND NOTES:

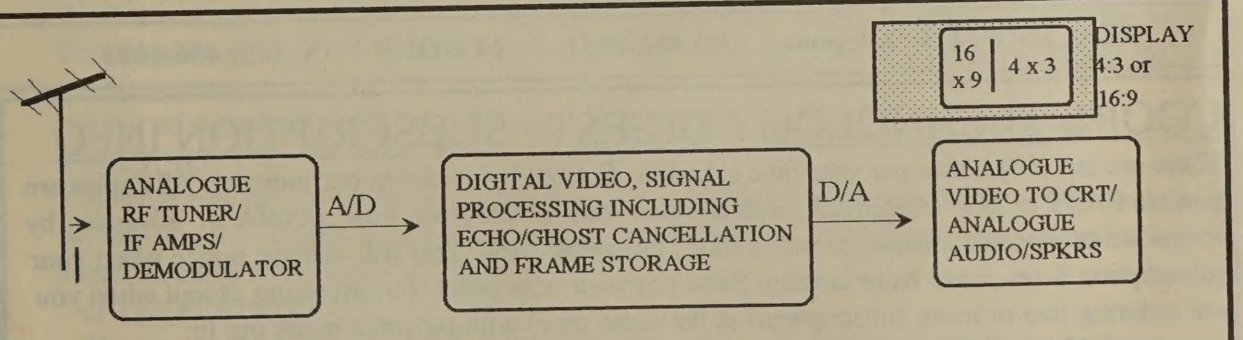
Present analogue video transmission requires spectrum bandwidths of 6 MHz to 8 MHz (with companion colour, audio sub-carriers) for the transmission of full motion video. From the bandwidth requirements of analogue video a number of differing channelization schemes have been created throughout the world.

Attempts to create analogue video worldwide standards began in the late 1940s, with little success. Complicating the analogue video standards impasse are the three different analogue scan line/field rate/modulation schemes created in the 40s and expanded in the 50s and 60s with the introduction of colour.

With three different, incompatible television standards (plus variations of the three basic formats), the exchange of video programming through satellites and/or videotape has become ever more complicated and expensive to implement.

Pressures to reach a single world standard increased with the development of compressed digital video. At first digital video was feared as another contender in the complicated format battles. Slowly it became clear digital video with compression could be a translation format; one which all other formats could adapt to as a transmission medium between locally chosen broadcast formats. This decision was strengthened when a worldwide standard known as MPEG-2 (with B Frames) was adopted by all of the major standards organizations (ISO, CCITT, CCIR et al).

At first it was believed that if a single digital standard was accepted, it would find deployment only in the linking of nations or regions of the world with individually differing broadcast standards (such as PAL-B or NTSC). This was before the robust nature of digital video was fully



1994 TRANSITIONAL TV RECEIVERS

COOP'S TECHNOLOGY DIGEST

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appreciated. More recently the use of MPEG-II as an actual end to end 'broadcasting standard' has been proposed and several nations are working towards that end.

When MPEG-B was viewed only as a 'linking format' between individual standards, its impact on national TV standards was not a consideration. During 1993 the USA and the United Kingdom have determined digital video could replace analogue video as a terrestrial transmission standard as well. In the USA the Federal Communications Commission has proposed June 29, 2008 for the termination of (NTSC) analogue transmissions.

With the adoption of MPEG-2 as a worldwide basic digital standard, television receiver designers are free to begin implementing the transition to digital receivers and VCRs. This is being done by creating TV sets which have analogue-digital-analogue 'building blocks'.

While each manufacturer is likely to be cautious with 'how far do we go with digital', at first, over the next two to five years each successive year will see digital circuitry going further and further into the set's design.

Digital circuits should not be confused with digitally transmitted television. Within a TV set certain functions (segments of the receiver) can be digital even if the transmission format remains analogue. Digital and analogue mixed, within a receiver, is ultimately more expensive than all-digital or all-analogue. But digital subsections allow far more freedom in processing the signal even if the transmission format coming to the receiver is analogue. Within the receiver the original analogue signal is converted to digital (called A to D or A/D conversion) so that 'digital tricks' can be employed; tricks such as eliminating ghosts or some forms of noise and sharpening/enhancing the colour display. Once those digital circuits have been employed, the transitional receivers will reconvert the digital signal back to an analogue format in a reverse converter called D/A so the final picture and sound are processed as analogue voltages before being displayed.

True digital benefits can only occur when the transmission format is also digital.

EARLY DIGITAL TRANSMISSIONS

Three separate 'transmission groups' are gearing up for direct-to-home digital transmission with no analogue component involved between the TV camera and the TV receiver display.

a) SATELLITE TV:

A satellite TV transponder (channel) is opaque to the type of format which passes through it; as a 'repeater' (in the sky) it receives, amplifies and rebroadcasts energy without regard to how that energy is configured.

Every (television) satellite now in existence or planned has the ability to relay digital television. All that is required is for the originating (uplink) station to transmit digital format to the satellite; the transponder will relay that (or any other) format (received) to the satellite's normal (ground) service region.

Tests of digital television have been conducted on satellite for more than five years.

b) CABLE TV:

A cable system is a 'secure spectrum' through which virtually any format may be transmitted; like the satellite, the cable is 'opaque' to the transmission format. Digital formatted television has been tested on cable for at least five years.

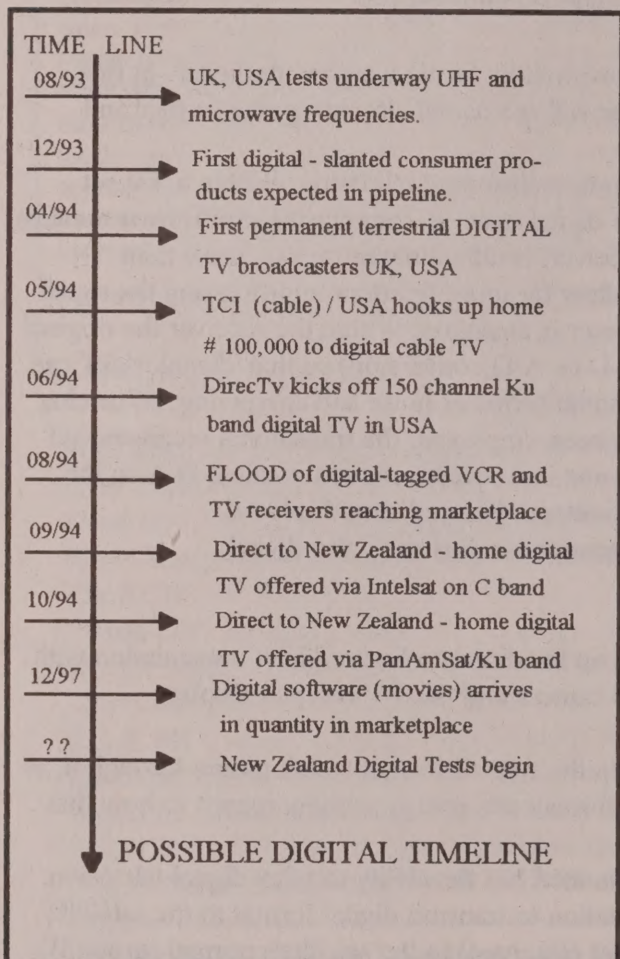
c) TERRESTRIAL TV:

The transmission 'medium', the atmosphere, likewise does not care what format is employed. However, the factors which degrade terrestrial television transmission through the atmosphere

(noise, terrain, co-channel interference) are basically analogue in content or their effects are enhanced with analogue transmissions. By employing digital format transmissions, most of the problems which plague terrestrial transmission are eliminated.

Digital terrestrial TV trials began in 1992 in the United States; 1993 in the UK. The results reported to date have been very dramatic pointing out greatly improved coverage ranges for transmitters, and using MPEG-2 digital format video, superbly enhanced video images free of interference or transmission 'artifacts'.

The testing results to date with satellite, cable and terrestrial transmissions strongly support a goal of converting all television transmissions to digital format as quickly as this changeover can be implemented. This brings us to a time frame for conversion to digital.



To change from analogue to digital requires the replacement of analogue equipment now installed at all broadcast stations/origination points. There is a not inconsiderable expense associated with such a change-out as every piece of equipment from the TV camera to the broadcast transmitter (including all amplifying, switching, processing units in between) must be replaced. Professional recorders and their associated electronic processing and switching hardware have been evolving to digital format over the past five years. Very few broadcasters will today replace such items with analogue hardware opting instead for the far more versatile digital replacements. However, like the 1994 'transitional television receiver', when a segment of the broadcast chain changes from analogue to digital there must be A/D and D/A conversion at each point of interfacing with pre-existing analogue equipment. Worldwide the changeover from analogue to digital at the broadcasting/origination end has been estimated to be a 'hundreds of billions of dollars' expenditure. Obviously this cannot be accomplished in a short time frame.

Even more perplexing is the opposite end of the circuit; the home receivers. Studies indicate there are more than 500,000,000 analogue TV receivers in consumer hands worldwide. If all analogue TV broadcasting stopped tomorrow and was replaced with digital format transmissions, every one of these receivers (and VCRs) would be useless.

In the United States a 'completion changeover date of June 29, 2008' has been proposed: 15 years. This is based upon studies which indicate:

a) The average American household buys a new television receiver every four years;

b) The average television receiver is 'retired' in 10-12 years.

A similar changeover period is being suggested in the United Kingdom; indeed, 'digital (FM) radio' (to be discussed separately) has a suggested year 2018 date when all analogue (FM) broadcasting within 'band II' will cease.

Other countries including Japan, Germany and France are expected to announce analogue to digital target dates by early in 1994.

To accommodate this potentially planet-wide conversion to digital broadcasting, each existing analogue transmitter will be 'paired' with a companion-programmed (simulcast) digital transmitter. Here the techniques will vary as each nation has its own VHF/UHF television allocations scheme and somehow room for new digital transmitters must be found within those spectrums; while analogue transmissions continue until the final analogue close-down date.

WHY THE CHANGEOVER AT ALL?

To understand why hundreds of billions of dollars in existing hardware would be targeted for replacement over a 15-25 year period requires a grasp of the field-test verified advantages offered by digital format transmissions. Progressive advances in the past (the introduction of colour, the introduction of teletext, the introduction of stereo TV sound) have always been accommodated by merging the new additions into the basic (PAL, NTSC, SECAM) formats. Why, then, should digital require a wholesale replacement of everything?

Video transmission requires 'spectrum space'. The highly complex video waveform requires so much space to transmit 'moving pictures' that a single TV channel (space) is greater than (for example) the entire AM radio broadcast band. In fact, it is as 'big' as six or more 'AM broadcast bands'; a single TV program occupies 'space' where more than 600 (AM) radio stations could operate! To initially accommodate television, an at-the-time unproven portion of the radio frequency spectrum (VHF; very high frequency) was consigned to television (1945-1960). This was only possible because no other or very few other users of this spectrum had spoken for it when television appeared. Given our subsequent knowledge of VHF, it is unlikely that television would have begun in this spectrum except under the circumstances that existed immediately following World War II.

In the 1945-1960 era all that was known about complex transmission systems (such as television) led to the conclusion that as the amount of information being transmitted became more detailed and complicated, the only answer to its transmission was to assign and use greater and greater bandwidths. Digital, a technology, was not even on paper in 1945 and barely functional as a laboratory curiosity in 1960. Analogue transmission is all about transmission space. Digital transmission is all about transmission speed. In 1945 it was possible to occupy more space with new technologies such as television; it was not possible to transmit 'faster'.

A simple black and white television picture has many component parts. The addition of programme sound (audio) adds a new component part. The further addition of colour, teletext, (NICAM) stereo all add new component parts. Each of these parts occupies space in the channel spectrum and there are inevitable 'clashes' between these component parts within the channel space. We call these clashes 'artifacts' which means when the colour portion of a signal happens to 'wander' outside or beyond its assigned space it creates yet additional undesirable component parts by 'clashing' or mixing with say the audio portion of the signal. As the original 6/7/8 megahertz channels created for black and white (plus sound) have been 'topped up' by adding colour, NICAM and other extra signals, these 'artifacts' have become more and more troublesome.

Plans to change the shape of television pictures, from a 4:3 aspect ratio to a 'wide screen' 16:9 aspect ratio or the creation of HDTV (high definition), for example, have been stymied for nearly a decade by these 'artifacts'. No suitable system has been found which can expand the aspect ratio and improve the definition of the pictures (to more approximate theatre screens) without creating new, destructive 'artifacts'. Thus the arrival of true 'wide screen' television has been delayed for five years or more because of this analogue-transmission roadblock.

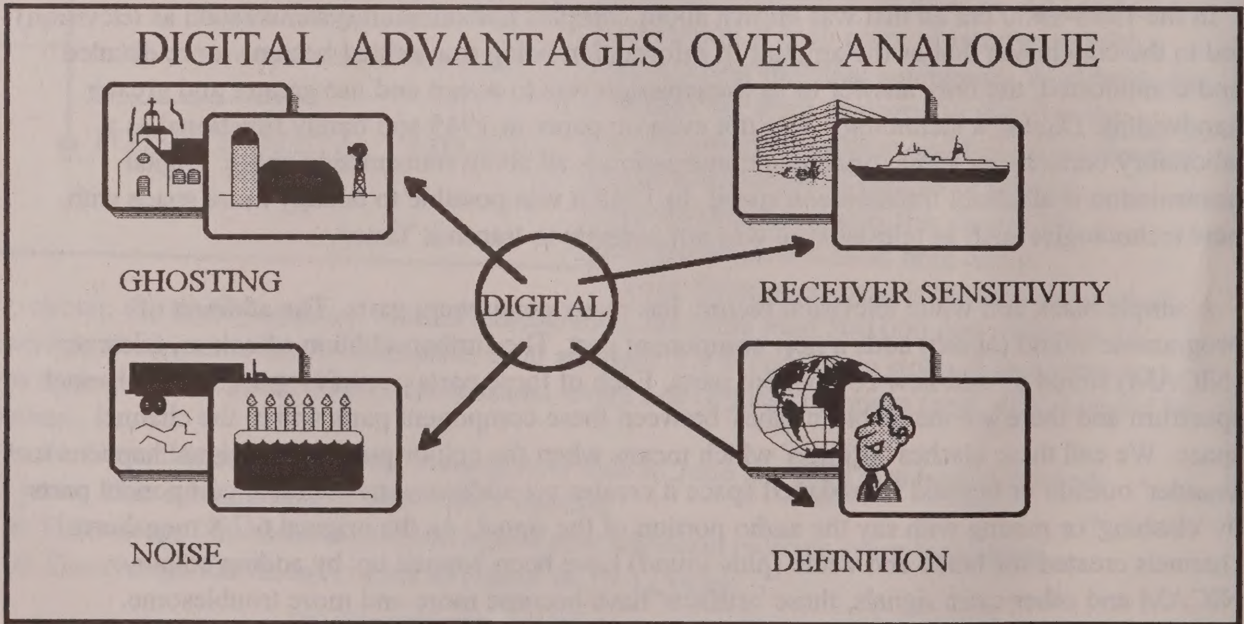
Analogue television also suffers from problems accentuated by the analogue format. Some of these problems include:

1) Ghosting or multi-path effects. In irregular terrain, or in large cities with tall buildings, transmitted signals arrive at receivers after traveling over two or more separate paths. In time, one of these paths is always 'later' or 'earlier' in arriving than the other. The result is a primary on-screen image and a secondary (ghost) on screen image.

2) Noise created by power lines, automotive ignition systems, electrical appliances plays havoc with 'clean reception'. All noise is analogue in content and it fights the TV signal for attention in the receiver. A picture disrupted by noise is unpleasant to view.

3) Receiver sensitivity. The range or reach of an analogue television signal is established by the 'threshold of sensitivity' of the receiver. There are physical limits to receiver sensitivity, no matter how extensive the engineering design, which come back to the analogue transmission format. Achieving greater reach or range with analogue transmission systems depends totally upon the transmission power and height of the transmitting antenna. Nationwide TV channel allocation schemes have been built throughout each world political unit (country) based upon these recognized limits.

4) Definition. A TV picture is created 'one line at a time' (left hand edge to right hand edge of screen). Like any photographic process, the greater the number of individual 'lines' for any image the better the clarity or definition of the picture. PAL-B format television has 625 lines on the screen; of which 576 lines are 'active' (i.e., utilized to show picture detail). High definition television (pictures with better detail than present television) has been proposed for more than a decade. Any technique to improve the detail or definition will require more lines of transmitted information; more than the present 576 'active' lines.



Each line of picture detail can be equated to a specific amount of 'spectrum space'; if you increase the number of lines from 576 to 1152, for example, you will approximately double the amount of space required in the spectrum for a single channel with an analogue system. Thus a band I or III New Zealand TV channel must be 14 MHz wide rather than 7 MHz to accommodate higher definition television (HDTV). Unfortunately, in the process of doubling the channel width to accommodate HDTV, the major shortcomings of analogue video multiply; i.e., receiver sensitivity becomes even poorer, artifacts become more numerous, interference becomes more troublesome.

It is not an oversimplification to state "*Digital solves all of these problems; and more.*"

Thus the total, wholesale changeover from the now 50+ year old NTSC/PAL/SECAM analogue formats to a single-standards based worldwide digital format is considered by many to be a worthwhile and timely expense.

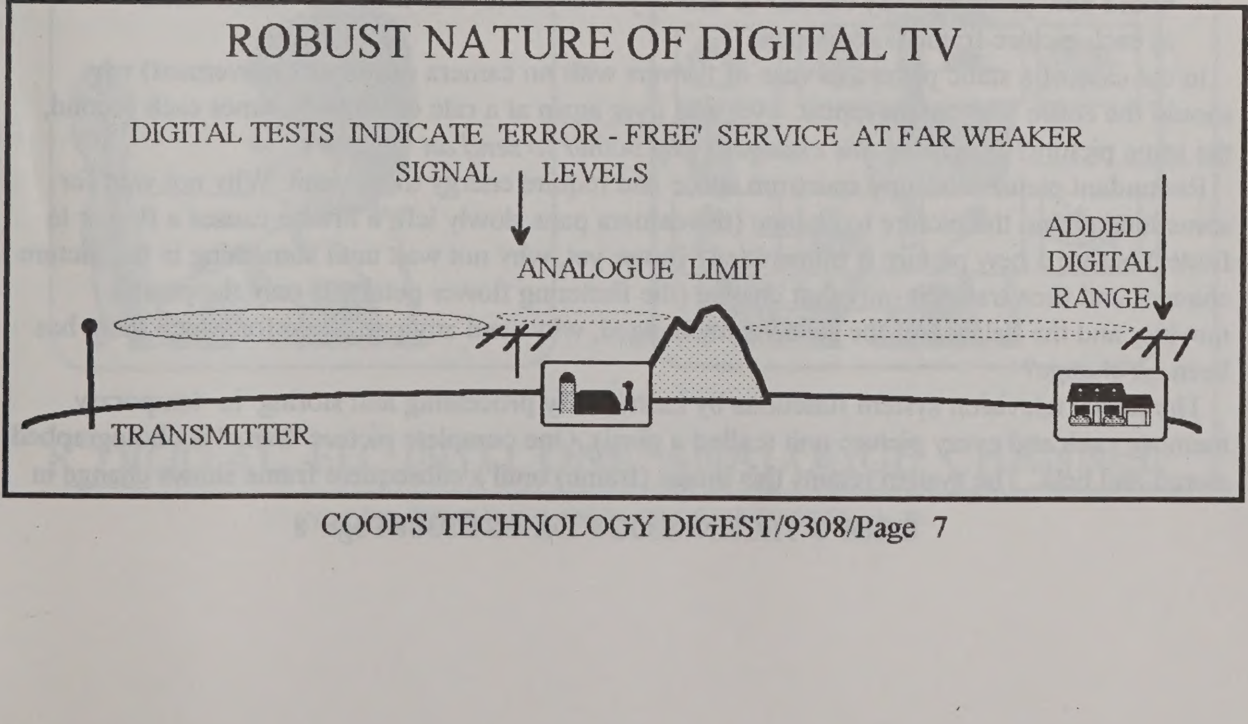
THE ROBUST NATURE OF DIGITAL TRANSMISSIONS

One of the more compelling reasons for converting to digital is the quantum improvement in signal quality while (a) using far less transmission power, and, (b) overlaying the service area (region where viewers dwell) with far less signal. Tests to date have shown:

London: A 50 watt, channel 28 transmitter using digital techniques produces the same or better quality TV pictures at a distance of 30 kilometres as an analogue transmitter operating with 5,000 to 50,000 watts. Tests beyond 30 km are underway.

New Jersey (USA): A 1,000 watt, channel 57 transmitter using digital techniques produces the same or better quality TV pictures at a distance of 120 kilometres as a 1,000,000 watt analogue transmitter at 80 kilometres.

Washington, DC (USA): a 10 watt, 2,600 MHz transmitter produces totally ghost-free pictures at distances varying from 1 to 30 km from the transmitter while a 100 watt analogue transmitter at the same site produces pictures riddled with multiple images and smeared colour and no usable pictures beyond 20 km.



UK engineers believe they will be able to reduce UHF TV transmitter power levels to as little as 1% (1/100th) of present analogue power levels and still retain the same 'reach' they now have with analogue.

In numbers, picture quality is measured by (a) signal to noise, and (b) blemishes or interference seen along with the desired video. A digital signal appears to be capable of 'error free' (a new term to be explained) reproduction of video with a signal to noise ratio of 20 dB. 'Error free' means every element of the original picture, as it left the television camera, is reproduced at the receiver site 'without error'. In analogue video reception there is no similar measurement phrase since 'some degradation' (error) always appears , even over very short transmission distances. The nearest phrase to 'error free' in analogue reception is 'studio quality'; a term reserved for pictures which 'to the eye' have the 'appearance' of being as good as a picture viewed at the broadcasting station itself on a studio monitor. Such a picture, in analogue format, has a signal to noise ratio (a measurement) of at least 46 dB (to as much as 57 dB). Thus an 'error free' picture via digital television is at least comparable with a 'studio quality' picture via analogue television; only it requires 26 dB less signal (46 - 20) than its analogue counterpart. This is the reason for BBC and other engineers planning a new (UK) nationwide digital service with transmitters operating at 1/100th their present power levels.

New Zealand examples: TVs 2 and 3, Auckland, presently operate with 325,000 kilowatts of effective radiated power. Following the UK power reduction plans, these transmitters could operate with 1/100th, or 3,250 watts, if used in a digital format and retain their present coverage areas.

THE EXPANDED NATURE OF DIGITAL TELEVISION

Analogue television requires 'spectrum space' to transmit detailed images. Digital television requires a far smaller amount of spectrum space to transmit the same detail as analogue; digital relies primarily on 'transmission speed' rather than space for detail'.

A totally comparable (line for line) digital signal requires approximately 1/8th (*) the spectrum space as an analogue transmission. This is possible because of a technique which, although recently refined, promises to totally revolutionize the transmission of video imagery. This is known as digital compression.

*/ Digital compression is a twin technology which recognizes that when a television camera is focused on an object or scene, and sending to the distant TV receiver 25 or 30 brand new pictures every second of that object or scene, that much of what it sends in each picture frame is redundant.

In the case of a static picture (a vase of flowers with no camera nor object movement) why should the entire TV system repeat, over and over again at a rate of 25 to 30 times each second, the same picture? *If nothing has changed, why bother to send an 'update'*?

Redundant pictures occupy spectrum space and require energy to transmit. Why not wait for something within the picture to change (the camera pans slowly left; a breeze causes a flower to flutter) before a new picture is transmitted? Better yet, why not wait until something in the picture changes and then transmit only that change (the fluttering flower petal)? If only the petal is moving, and the balance of the scene is unchanged, why send any part again for which there has been no change?

The digital television system functions by individually processing and storing in temporary memory each and every picture unit (called a pixel). One complete picture 'frame' is photographed, stored and held. The system retains this image (frame) until a subsequent frame shows change in

the picture. The digital memory is continuously 'measured' for change and when change occurs only that change is added to the previously stored picture frame. If 10% of the picture changes, 90% of the picture in storage remains untouched.

In creating a standard for digital television, the types of video normally encountered were carefully quantisized. Grades of 'picture change' were created; such as 'Standard TV' and 'Live Sports'. A scene in the programme The Bill would be graded 'Standard/Broadcast TV' while a scene in a Rugby Test would be graded as 'Live Sports'. The percentage of change, picture frame to picture frame, in The Bill averages far less than within a Rugby Test. From this system evolved a method of rating 'on average' how much of the scene, frame to frame, was likely to change. A telecast wherein 50% of the total frames transmitted are redundant allows the TV system to 'loaf' the other 50% of the time (i.e. no change, no new transmission). From all of this 'averages' were found. If 50% of the time the system was 'loafing', then during that 50% of the time, two new 'tricks' are possible:

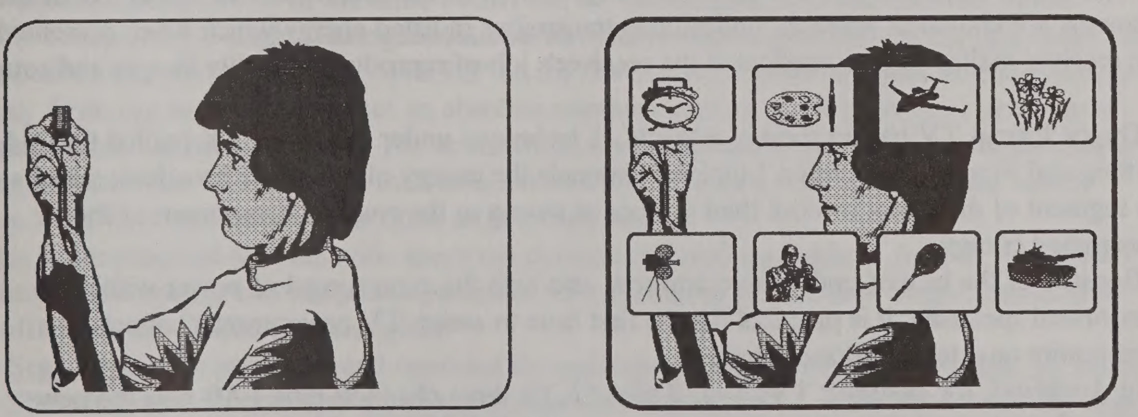
1) An entirely unrelated TV picture could be transmitted in exactly the same frequency or spectrum space, and/or

2) The 50% on / 50% off picture could be 'squeezed' in time so that it would occupy only half of the 'spectrum time'.

This brings us to digital compression. When no change is occurring in the picture, nothing is transmitted. The TV set in the home is being constantly 'refreshed' with the last image sent because there is no change; the 'refresh video' coming from the 'memory chip' in the digital TV set. In digital television, spectrum space is time. If over time there is no new information transmitted, then no spectrum space is used. This allows the actual changes to be compressed in time because only the change is transmitted; not the entire image over and over again.

The net effect is that a TV picture can be shrunk in 'space' utilized. If every 'TV channel' is now smaller, that means we have many new TV channels with digital format that we did not have with analogue television. On average, 8 digital (625 line, 4:3 aspect ratio format) compressed television programmes might fit into the spectrum space now occupied by a single analogue TV programme.

In New Zealand: There are 11 VHF (bands I and III) 7 MHz wide TV channels, plus 36 UHF

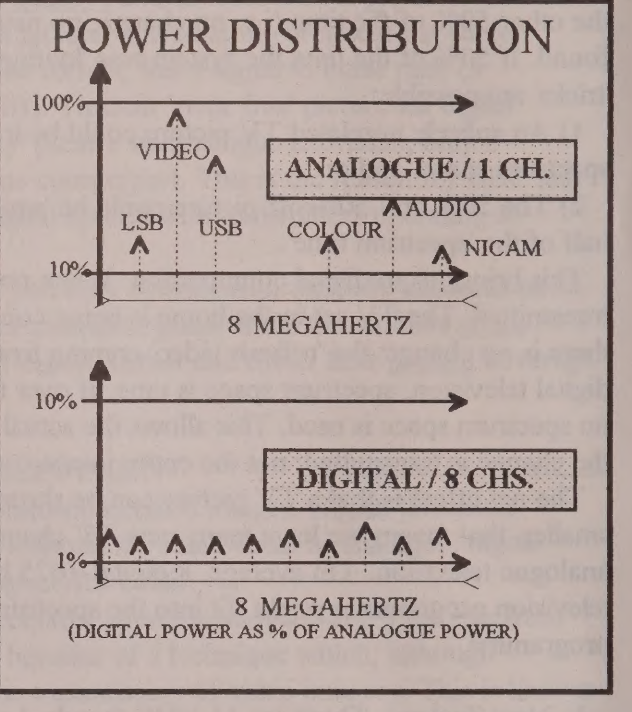


8 DIGITAL FIT INTO ONE ANALOGUE CHANNEL

(bands IV and V) 8 MHz wide analogue TV channels. If all 47 channels were converted to digital format 8:1 compression video, there would then be spectrum space for up to 376 (8 x 47) separate TV programming channels.

END OF ARTIFACTS

An analogue TV transmitter generates two completely usable TV pictures called 'lower sideband' and 'upper sideband'. At the TV transmitter, the lower sideband is mechanically 'filtered' so it does not radiate (transmit). This is done because both sidebands contain the exact same information (picture content) and only one is required for reception. In the process of 'filtering out' the lower sideband, the TV channel immediately below the operating channel is rendered useless in the vicinity of the TV transmitter; i.e., channel 7 in Auckland has a filtered-out but still disruptive lower sideband which 'leaks' into the airwaves on channel 6. This means, with an analogue transmission system, channel 6 cannot be used for TV transmission in or within approximately 100 km of Auckland.



An analogue TV transmitter has pronounced 'power peaks' and power 'nulls' within its 7 (8) MHz bandwidth. There is a great deal of energy at the picture carrier upper sideband frequency for example; another 'power peak' at the colour (sub)carrier frequency, still another at the aural (sound) (sub)carrier frequency and finally another at the NICAM (sub)carrier frequency. These power peaks and nulls result in very uneven power distribution through the 7 (8) megahertz wide channel. And as previously mentioned, when components of the colour (sub)carrier energy 'crawl' into the aural/sound (sub)carrier portion of the channel, there is degradation of the sound (or vice versa). All of these elements are known as artifacts, undesirable transmitter radiated energy which when presented to the receiver makes more complicated the receiver's job of reproducing quality images and sound.

Digital format TV has no serious artifacts. A technique under test in the UK (called OFDM / Orthogonal Frequency Division Multiplex) spreads the energy of a digitally broadcast signal so that no segment of the signal is more than 4 times as strong as the weakest component of the transmitted energy.

Because of the lack of undesirable artifacts, and with the even spread of power within the transmitted spectrum, it is practical for the first time to assign TV programme channels in a community on a totally adjacent basis.

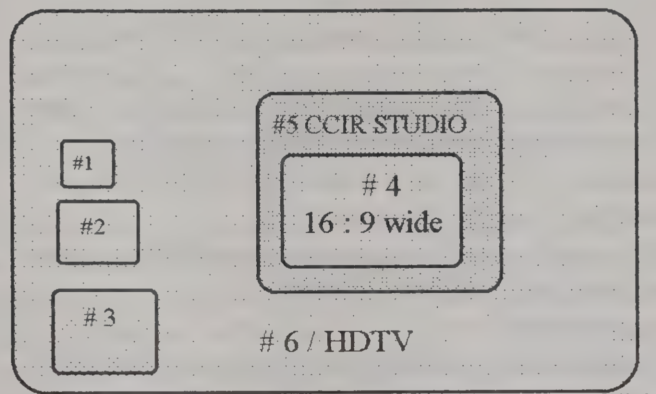
In Auckland, for example: TVs 1, 2, 3 plus SKY's three channels plus TAB plus the new 'Christian' channel (8 total) could be assigned new digital 'channels' all within the 8 MHz spectrum now occupied by a single SKY analogue channel. This would greatly simply the design of (smaller) TV aerials for Auckland and in no community would there be a

need to mix low (band I) and high (band III) channels together; a radical improvement for those installing home antenna/receiving systems. Band I channels, which have always been more susceptible to interference from 'skip' and man made noise sources could easily be vacated in toto with a switch to digital format transmission.

NEW VIEWER OPTIONS

Some top-price end television receivers presently offer a feature known as 'picture in a picture' or PIP. Using a rudimentary digital technology, these TV receivers combine two separate TV signals into a 'merged display' such that one of the two channels appears full screen while the second channel (selected) appears as an inset with a smaller picture. The primary use for this at the moment is to allow the viewer to 'monitor' a second channel (such as a Rugby Test) while devoting most of their attention to a second programme (such as Holmes).

HOW DIGITAL FITS INTO 8 MHz



An 8 MHz wide channel can handle approximately 30 Mbps of digital data. #1/teleconference video (1.152 Mbps), #2/film, broadcast TV (3.456 Mbps), #3/live sports (4.608 Mbps), #4/16:9 wide aspect (5.760 Mbps), #5/studio quality CCIR 601 (8.064 Mbps), #6 HDTV (14-24 Mbps)

Virtually any TV sporting event in the world employs two or more cameras covering the action; each camera has a different perspective of the play. With analogue television formats in use between the sporting event and the home, at some point a director has selected which of his two (plus) camera scenes he wishes to show. The home viewer has no such selection.

Digital tests conducted in the USA promise to change that. Because as many as 8 separate TV camera views (i.e., 8 different perspectives of the same event) can be 'compressed' into the spectrum space normally occupied by a single (analogue) camera view, tests have shown up to 8 camera views can be transmitted directly to the home. With PIP on the TV set, the viewer becomes his own director selecting from (up to 8 but that is not an absolute number) camera views on offer at any instant during the event. In this example of PIP seven small insets appear on the screen, each showing a separate camera view. The eighth is the 'main selected' view. With a remote control the viewer changes 'their view' of the action as often as he or she wishes.

This is not practical with the wide spectrum demands of analogue video. And, if that feature is unlikely to change the way the public perceives their television set, the new Sega Channel now being offered in the United States might.

The Sega Channel is produced and operated through approximately 10,000,000 cable TV homes in the USA. It is a totally two-way inter-active channel operated by the same Sega company which produces Genesis TV game programmes and terminal equipment. Sega's view of the future is that rather than a game customer going to a local store to purchase a new game cartridge, he or she will

merely dial up the Sega Channel and, with inter-active two-way digital TV, be downloaded with a (Genesis) programme for as long as they wish to use the game.

And if games are not of interest, a new project funded by a consortium of IBM and Apple (computers) may be, again, using inter-active two-way digital television. Their 'Kaleida Labs' project interfaces the home TV set with a master computer network such that each individual home has customized access to millions of pages of reference and current affairs data. The viewer issues instructions on his telephone/cable TV modem connected keyboard and the digital network locates a 'vacant' data channel (not in use), fills it with the reference data ordered, and transmits the data to the user through the air or through cable. All of this is leading towards the eventual merging of the home television receiver and personal computers.

The digital 'revolution' would appear to have some benefits for every portion of the TV world.

For the viewer:

1) Vastly superior reception quality, especially in areas with difficult terrain or where present analogue signals are weak;
   a) when enhanced definition (HDTV) is added to the broadcasts, double the present picture resolution;
   b) '70 mm-like' wide screen, 16:9 (or other) wide screen, when added to the system.
2) Access to two or more camera views per programme with the viewer making the selection; when added to the system (perhaps on a programme by programme basis, on some networks but not others; a matter of competition)
3) Surround sound (enhanced stereo), most likely with the introduction of wide screen programme formats (not to be confused with simplistic stereo)
4) Multiple channel simultaneous access with PIP
5) Simplified aerials; the result of closer channel groupings and the more robust nature of digital TV displays even with relatively weak signals
6) Multiple language audio for programmes; an almost unlimited number of sound channels are possible with digital audio embedded in the digital video transmission.

For the broadcaster:

1) Increased or same coverage areas with approximately 1/100th the present transmitting powers which will reduce operating and maintenance costs
2) Opportunities to send two or more views of the same event from differing camera angles; a 'commercial opportunity' to gain viewers
3) With digital interconnection between transmitters, the opportunity to transmit totally different programmes either simultaneously to all viewers or separate programmes to different portions of the country or even coverage area (i.e., "South Auckland News", "North Shore News", "Central City News")
4) Opportunities to serve ethnic minorities with their own embedded language channel while not interrupting other viewer choices of a wider-use language (Maori and English simultaneously, for example)

For Government/Ministry Of Commerce:

1) The opportunity to revise all channel allocations nationwide, perhaps eliminating troublesome band I (channels 1, 2, and 3) and even band 3 (channels 4-11) totally as with 36 remaining UHF 8 MHz wide channels up to 8 x 36 or 288 separate TV programmes would be

feasible in any single area;

a) In the process of gaining back TV band I and perhaps III channels, they could be reallocated to other commercial services such as business and public service two-way radio

b) The opportunity to revisit the Management Rights Auctions for UHF TV channels (the definition of a channel may change as well since an existing analogue 'channel'/as auctioned off, can transmit as many as 8 simultaneous TV **programmes**)

2) The opportunity to establish low-in-cost (capital and operational) public TV service since additional video programmes can be piggybacked on commercial transmissions for a fraction of the cost of creating totally new transmission and relay facilities for public TV.

BLUE SKY?

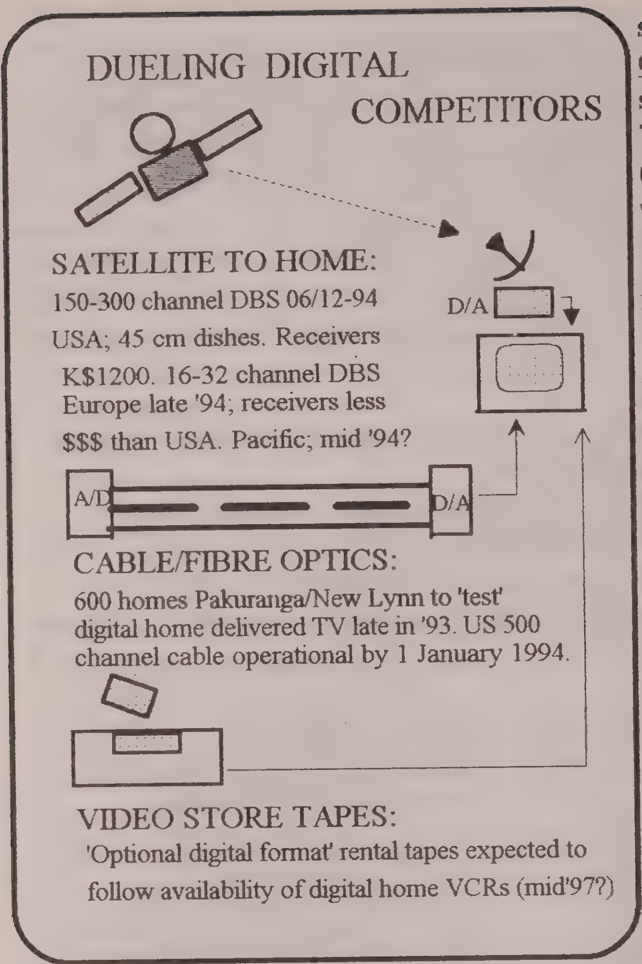
Predictions of major changes in the television/radio broadcasting systems have appeared from time to time in the past. How real is digital format television?

Consumer products for 1994 (television receivers, VCRs) will be extensively digital; that's already announced by leading Japanese and American designers. As noted on page one, however, until there are digital transmissions available the TV receivers will continue to be hybrid (part analogue, part digital) because they must interface with existing analogue equipment and analogue transmissions. When will digital transmissions begin?

1) USA: The Federal Communications Commission is now allowing digital testing. A new allocations table which allows new digital channels to co-exist with established analogue transmitters is due before the end of 1993. When the allocation's table is published, existing TV stations will have first call on digital channel space so they may begin 'simulcasting' in analogue and digital. By June 29, 2008 the FCC has proposed all analogue transmissions cease. In the interim, new TV receivers in the marketplace will allow the viewers to receive first either analogue or digital telecasts, later only digital.

Major USA cable TV system operators (TCI, Time-Warner, Coax Cable, Cablevision Systems et al) are presently installing digital-based wideband networks (750 MHz plus) in more than 350 US cities. TCI, the largest cable operator in the world, will complete more than 7,000 cable miles of digital rebuilt cable plant in 1993 alone. The firm has on order more than 1.6 million Jerrold Electronics digital expanders for installation in cable subscriber homes during 1994. The 'Digital Converters' are an interim technology interface that will allow TCI to transmit down their cable lines in digital video format, directly into the homes; the converters will receive the digital signals and do a D/A conversion to allow existing analogue TV sets to utilize the digital services. As customers purchase their own digital-design TV sets, many of the D to A functions of the converter will be automatically bypassed. TCI has announced it expects not fewer than 10,000,000 US homes to be digitally on line through existing cable systems by the end of 1998.

A consortium of established satellite TV operators, Hughes/General Motors and RCA/ General Electric are on target to launch new satellites around 1 January 1994 which will offer 150 channels of digital format television to virtually every home in the USA plus most of Canada, Mexico and much of the Caribbean. The services are due to begin operation between April and June 1994. The primary supplier of the totally new design digital



satellite TV home receiving systems, Thomson Consumer Products, expects the total home systems to sell for around US$700; K$1260 . The satellite dishes will typically be 45 cm (.45m) in size. The operations firm, DirecTv, will be joined by competitor USSB later in 1994 with its own satellites offering another 150 channels of direct-to-home digital satellite TV.

2) Europe: Direct to home digital television is being tested in London; additional transmission sites are under construction. Significant planning has been done to identify 'channels' presently unsuitable for analogue TV which could be placed in service for digital format TV; to allow 'simulcasting' in both formats from an early date. Germany and the Scandinavian countries will follow suit later this year; largely driven by their respective TV receiver manufacturers who depend upon exports to earn foreign exchange revenues.

English cable TV is following the same direction as USA cable systems, rushing to add digital transmission channels on existing largely fibre-optic technology broadband systems.

European direct to home satellite broadcaster ASTRA plans digital transmissions along side (parallel to) their present analogue transmissions from late 1994 or earlier. They say they will begin as soon as significant digital design home satellite systems are in the distribution stream. British Telecom plans to be selling home TVRO systems, including digital format systems, by Christmas 1993 through their BT retail stores. BT forecasts 35% of British homes will have digital satellite TV systems by the year 2000. As with terrestrial TV, the more robust nature of digital TV will cause the size of home satellite antennas (an environmental issue in the UK and continental Europe) to shrink dramatically.

3) Hong Kong's brand new Wharf Cable plans to have digital channels on the cable by January 1994. Six regional subscription channels offered by satellite operator STAR TV will be amongst the services offered.

RECEIVING HARDWARE

In the extremely competitive consumer electronics market few brand name firms (i.e., Sony, Panasonic, et al) will tip their product hand before the 1993 Christmas buying period or the early 1994 industry trade shows. Most agree that because the ISO/CCITT/CCIR adoption of MPEG-B (digital TV standards) only occurred earlier in 1993 that there is a race underway to see which brands using what models can implement the new worldwide standard first.

With an agreed-to standard, the crucial finalization of special purpose digital TV memory and processing chips proceeds. The initial chips will have a capability of 10 Mbps (10 megabytes per

second) and firms such as LSI Logic and Philips Consumer Electronics Co have formed alliances to create the new chips and rush them into production. With the 10 Mbps chips as a 'building block', other firms such as DEC (Digital Equipment Corporation) forecast the 'strapping' of chips in 10 megabyte sets to perform more complicated memory and user programme selection and retention functions.

With USA cable giants forecasting as many as 10,000,000 (US) homes to be equipped with digital format TV capabilities in just over four years, cable hardware pioneer Jerrold/General Instrument has announced a radically new direction for home TV receivers. Called 'Joey' (after the kangaroo pouch), Jerrold is introducing a modularized home television receiver that is actually a shell with a picture tube and its associated high voltage supply. Joey has snap-in modules to allow the customer to select the particular mix of analogue/digital signal processing and display equipment he wishes, up to and including interfacing with popular RGB output Personal Computer systems. Jerrold believes that if the changeover to digital processing of video is going to be as widespread as most television and computer designers are forecasting, the consumer will be best served by owning a TV receiver without any 'guts'; capable of being module-by-module upgraded on a selective basis by the consumer. Jerrold believes that developments to come with digital signal processing, and the eventual marriage of the home digital receiver with multimedia hard and software, will antiquate conventional TV set designs often before they are unpacked from their shipping cartons. Jerrold plans to give the consumers a choice by allowing them to purchase the basic 'shell' and then offering modules for specialized applications, on sale or for rent/ lease, through the local cable operator.

Toshiba is now shipping the first consumer marketplace fully digital HDTV VCR.
Expect a considerable amount of consumer confusion in the marketplace over the next 18 months. Consumers will hear about 'digital television', high definition television, and wide screen television and not understand that each is a stand alone product or service and that all three may not be available in a single unit (TV receiver or VCR) for two or more years. Still fewer will comprehend that unless they have locally available broadcast HDTV, wide screen TV or digital TV, they will have to be satisfied to use their new appliances with tape-only products, when the tape players and the software to support them become available. Some of the name brands will be adding to the confusion by offering hybrid analogue-digital equipment which they will claim is 'digital'. Both JVC and Panasonic will offer 16:9 wide aspect ratio (they will call it wide screen TV) sets in 50 and 58 inch (width; not diagonal) sizes later this year. Philips and Sharp will offer 16:9 34 inch direct view screens as well. In the home, a transmission in the 4:3 aspect ratio will display with (automatic) 'letter box' format bands on each side of the screen (i.e., the consumer will have a 16:9 TV screen but the 4:3 transmissions will only fill a portion of the screen). When a TV station transmits a 16:9 in its 16:9 format, the standard TV sets end up with letter box formats at the top and bottom of the

NZ CONSUMERS CAN HAVE -
(with proper new equipment)

16 : 9

Wide screen from tape (1994)
Wide screen from digital tape (early-mid 1997)

4 : 3

Wide screen plus digital from satellite (late 1994?)

HD wide screen/digital from:
tape (late 1997)
satellite (late 1994)

NOTE: No New Zealand telecaster has made an announcement concerning digital / 16:9/ HDTV to date.

screen; the picture has been shrunk to fit the full width of a 4:3 screen, but this leaves it short of the full height.

Adding to the confusion will be a JVC system that 'progressively stretches' the 4:3 ratio images into a 16:9 image. Those who buy these sets will 'swear' they have widescreen TV perhaps not realizing that clever designers have found a way to s t r e t c h the original 4:3 pictures like a latex balloon expands when filled with air. And then to further confuse the poor consumer, Thomson Consumer Electronics is now selling a wide screen VCR that transmits a code to the TV receiver when a rental tape recorded in 16:9 is connected to a (Thomson) 16:9 34-inch direct view TV set. The code tells the TV set to switch from 4:3 letter box to 16:9 so that the original 70mm wide screen theater display can be seen.

If this much confusion can be attached to the simple display of analogue video tapes, the next few years with claims of 'HDTV', 'digital TV' and 'wide screen TV' will be a challenge to the marketplace. And the broadcasters haven't even begun their hype yet!

Nor the programmes-on-video firms: wait until the consumer is faced with 'Digital or analogue?' decisions at the rental store. The next decade is destined to be unlike any previous decade in home entertainment.

DIGITAL SUMMARY - IN A NUTSHELL

For the engineering or management executive too busy to fully assimilate the detail of the 'digital revolution', these summaries (guaranteed to be conversation stoppers at cocktail parties).

SPECTRUM CONSERVATIVE: Digitally compressed video limits will continue to evolve for a decade or more; with present technology approximately 8 broadcast programmes will fit into the 8 MHz space of a single analogue TV programme.

POWER ADVANTAGE: In terrestrial AM-mode, digital is at least 20 dB better than analogue on a programme for programme basis (partially due to narrower bandwidths) and in some tests has been nearly 30 dB 'better'. Bottom line? TV transmitter powers can be reduced by 20 dB (to 1/100th present powers) for same coverage as analogue.

MORE ROBUST: In the presence of interference or noise, far more capable of delivering 'error-free' pictures than analogue. Intriguing 'cross-polarized' tests now underway in UK use same frequency space for two separate transmissions in exact same area; frequency 'reuse' ala satellites with 60 Mbps of information in an 8 MHz wide space.

EXPANDED QUALITY: For enhanced video (high definition, wider screen et al) transmissions, the only way to get the data rates required without overrunning the available spectrum space.

VIEWER VERSATILE: The possibilities offered by simultaneous transmission of two or more separate images for same programme barely dented with tests to date; the viewer will ultimately be his/her own director.

EXPANDABLE: The sleeper; once all video is delivered digitally, future expansions or upgrades will be accomplished totally with software. And software can be transmitted or recorded or preprogrammed on replaceable chips. It is virtually future-proof.

TECHNOLOGY
BYTES

.......BITS AND BYTES YOU MAY HAVE MISSED IN THE RUSH TO MAKE A BUCK .....BITS AND BYTES

APPLE COMPUTER will be working with New Zealand communications supplier BELL SOUTH plus USA Ameritech and U.S. West to create FAX and phone services for Apple's latest hand-held computer, Newton. The newly introduced Newton is a palmpad-sized computer sans keyboard that accepts hand drawn messages with interfacing abilities to IBM compatible or Apple 'fixed' computers.

MPEG-2 worldwide agreement may have established basis for world's first planet-wide TV distribution format but of greater importance is much quieter agreement to adopt universal header descriptors. The newly adopted header standards tell a digital tool (call it a computer, call it a TV set, call it anything you wish) just what kind of media bundle is being transmitted to it. Some are already tagging them as Universal Product Codes for multimedia; universally recognized digital instructions to tell your computer, 'smart' TV set, satellite receiver or cable converter the form and format of the material 'to follow'. Given this 'electronic bar-code' description, your interface tool then goes to work to process the data you have selected.

RIMSAT, Tonga-licensed international satellite service provider mentioned in New Zealand Herald story (*06-07-93; page 9*) is serious contender for trans-Pacific satellite TV and narrowband communication services presently carried exclusively by Intelsat. Tongasat is Tongan based venture headed by Dr Mats Nilson, himself retired from Intelsat. When 16 above-equator satellite parking spots went out to tender in 1988, Tonga at Nilson's urging applied for and won 6 of them. They could be worth billions to Tonga over the next two decades since each 'satellite parking spot' can be rented or leased to anyone with a satellite looking for a spot to operate. One such group is RIMSAT, an Indiana based US company *(1911 Production Rd., Fort Wayne, In. 46808; phone 001-219-484-6474; FAX 001-219-484-4547*) which capitalized on Glasnost by arranging to lease Russian built and launched Raduga and Gorizont class 'spare satellites' from Russia. The first, offering 3 C band (3.7-4.2 GHz) transponders are scheduled to their station at 134 east, has maximum footprint of 34 dBw (translates to 2 metre ground dish for excellent video) but no more than 31 dBw over New Zealand (3.5M dish). *Tongasat/Dr. Mats Nilson LPL Center, 22nd Floor, 130 Alfaro Street, Salcedo Village, 1200 Makati, Metro Manila, Philippines; FAX 63-2-817-6112 and 63-2-812-1033.*

TELECOM fibre to the home experiment involving 600 Pakuranga and New Lynn test market will utilize fibre electronics hardware produced in Australia. SKY has deal to provide programming which will include pay per view movies.

Wellington may not escape test-trials of cable television service. Small pockets of terrain shielded homes, often fewer than 100 homes, have been identified by firm now planning traditional coaxial cable (master antenna) services. Possible suppliers are being asked to redesign cable line amplifiers to allow carriage of NZ channel 1 (45.25-51.100); traditional North American and European cable plants begin cable distribution at 55 MHz and reserve regions below 50 MHz for 'return-line' (two-way) applications. NZ channel 1 overlaps forward/reverse bands.

Kapiti Coast Kiwi Cable has successfully accessed approximately 12 US cable television service channels from US domestic Galaxy satellites beaming towards Hawaii, using 16.5 metre dish. Reception, described as 'adequate for cable distribution', culminates more than a year of testing. And the bad news; none of the programme channels available on the big dish can be licensed by Kiwi Cable for use according to principal Todd Klindworth. He claims NZ SKY TV, largely owned by US cable giants TCI et al, have through US ownership ties preempted virtually all US cable programmes for exclusive SKY use; even if SKY has no room for, or , interest in such programmes at this time. Kiwi Cable negotiated end-run agreement with US CNN network for Kapiti Coast coverage against SKY objections, but at sizable 5-figure (US$) annual fee.

South Island would-be cable TV pioneer Civic Enterprises Ltd is back with a new plan. Civic toured multiple north and south island communities as far back as 1989 urging communities to grant cable licenses to firm. Now they are behind something called PacSat which is promoting 'wireless cable' package in Greymouth-Cobden-Paroa area. Company literature asks $250 per year for four in-home TV channels after $125 installation fee. Technical concept is to utilize 2.1GHz region frequencies to distribute TV through air. Within each city block or enclosed enclave they would install master 2.1 GHz receiver which downconverts microwave signals to standard VHF for distribution. Conventional cable TV networks interconnecting 8-20 homes to each 'receiver' would distribute the channels into homes. PacSat wants to avoid attaching cables to existing power utility poles; will run down fencelines or underground. Greymouth point-people Dave Bowden and Keith McDonnell reported approximately 150 homes had shown an interest in the service by mid-July; goal is 1,000 homes minimum to launch service. *PacSat Communications Ltd, PO Box 1959, Christchurch.*

WHAT do consumers expect from multimedia communications? Paul Saffo, Institute for Future, Menlo Park (Ca) says those firms and packages that will succeed in next decade will focus on four areas of consumer interest, in descending order of importance: (#1) Entertainment with emphasis on movies, (#2) Desire to communicate with emphasis on providing more than simple voice and FAX (graphics and video will drive the new multimedia success stories), (#3) Transactions, the ability to buy and sell goods and services through a multimedia terminal without ever leaving home or office, and, (#4) Information ... a very weak 'fourth' according to Saffo. "*People almost never want information for its own sake... .*"

COMPUTERCATIONS? CompuCations? Multimedia groups are searching for the just-right root-word to drive the newly emerging industries building around the marriage of home video, TV sets, inter-active TV, games and information delivery. Think of the right word, trademark it, and retire on the royalties!

VIDEO production technology is still big bucks in New Zealand. Possibly not for long. Five years ago Topeka, Kansas (US) firm New Tek Inc. conceived a digital video interface for IBM/Amiga/Apple breeds of computers which would allow complete amateurs to create network quality super sophisticated overlay/dissolve/3-D animation special effect videos with nothing more elaborate than home quality palmcorder and VCR. Company released **Video Toaster** 1991 launching 'desktop video production' industry that looks to be close to US$.5B this year. New state-of-art Video Toaster 4000 has (US)$5,000 price tag and just announced competitor Silicon Studio has (US)$15,000 base price package that does Disney-like animation plus amazing image compression feats.

IN THE NEXT FEW ISSUES

OF

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